TECHNICAL DISCUSSION OF COINCIDENT PEAK, NON-COINCIDENT PEAK AND MAXIMUM INDIVIDUAL PEAK

Definition of Coincident Peak

Coincident peak demand is the demand of a consumer at the time the system reaches its peak load for the entire year. In the case of ComEd, this generally occurs on a hot summer weekday in the mid or late afternoon. For ratepayers who have time recoding meters, the coincident peak is easy to measure – one simply pulls out the level of energy use at the time of the system peak. For residential and small business ratepayers who do not have meters that record hourly loads, ComEd must measure the coincident peaks using load research. This load research involves taking selected samples of various small consumers with time recording meters. Sampling may generate errors in measuring the true load that occurs at the peak hour for all ratepayers. However, because the total system wide peak load is known and because the metered load of large consumers with meters that record individual load is known, the remaining coincident peak can be measured more accurately than the non-coincident peak which is discussed below.

Definition of Coincident Factor and Diversity

Coincident peak is less than (or equal to) the sum of the maximum individual peak demands of all consumers on a system because some ratepayers (such as space heating customers, ski lodges, schools, churches, and lighting customers) do not reach their maximum peak demand at the time of the system peak. One can compute the coincident factor for a customer class as the coincident divided by the sum of individual peak demands of the class (this is not the within-class diversity discussed below).

Coincidence Factor = Coincident Peak Demand/Sum of Individual Peak Demand

Since the coincident peak must be less than or equal to the sum of individual demands, the coincident peak factor must always be less than or equal to 1.0. The diversity factor measures how much the difference between the coincident demand and the sum of individual demands can be defined as one divided by the coincidence factor. Calculation of diversity using a very simple example is illustrated in the table below.

Calculation of Diversity Factor				
	Customer 1	Customer 2	Customer 3	**Total Load**
Winter Load	100	0	0	**100**
Peak Load Hour	50	100	60	**210**
Autum Load	0	0	100	**100**
Maximum Individual Demand				**300**
Coincident Peak Demand				**210**
Coincident Factor				**70%**
Diversity Factor				**1.43**

Definition of Individual Maximum Demand or Billing Demand

Individual maximum demand or billing demand is simply the sum of the maximum demand for all customers in a rate class regardless of when the demand occurs. For individual maximum demand, there is no diversity according to the equations shown above. The sum of the maximum billing demand will always be greater than or equal to the coincident demand. This is because if the maximum individual demand for every single consumer occurs during the system peak hour, then maximum individual demand will be the same as coincident peak. From the perspective of cost causation of primary distribution facilities, measurement of ***system-wide*** individual maximum demand does not have much if any significance. This is because primary costs are driven by maximum actual ***regional loads*** experienced on the equipment. One can tabulate higher loads than coincident peak and claim that these loads provide some kind of margin of safety for construction of primary facilities. However the higher loads are not relevant because they are never faced by the primary distribution equipment.

Measuring and summing the loads for residential and watt-hour customers -- customers without time recording meters -- is more difficult than tabulating coincident peak because the sampling must accurately encompass all hours of the year rather than only one coincident peak hour. Further, the sampling must account for variations among consumers. The sampling is also less reliable because there is no aggregate figure for maximum demand (as in the case of coincident peak) that can be used as verification for the maximum demand.

Definition of Non-Coincident Peak

Non-coincident peak as defined by ComEd -- in contrast with a definition presented in the NARUC Cost Allocation Manual discussed in the main part of my rebuttal testimony – is supposed to compute the maximum system-wide load of a customer class, coincident with the class itself, but ignoring the aggregate loads placed on distribution equipment by other customer classes. Because of diversity among customers in a class, the non-coincident peak load for a class is always less than or equal to maximum individual demand. Instead of computing diversity with respect to the coincident peak load through dividing maximum customer load by the coincident peak load for all customers, one could compute diversity with respect to non-coincident load. Within-class diversity involves computing individual

peak demands of the class relative to the class peak load that is not placed on distribution equipment as illustrated in the equations below.

Within-Class Coincidence Factor = Class Peak Demand/Sum of Individual Peak Demand

Within-Class Diversity = 1/Within Class Coincidence Factor

Within-class diversity contrasts to diversity relative to the entire system-wide coincident peak load discussed above. For customer classes that have a lot of diversity within the class -- for example, a factory, a church, a school, a ski slope and a swimming pool -- the non-coincident peak is low compared to the maximum system demand and it can be as low as the coincident peak demand. For this type of customer class, the within-class diversity is high. On the other hand, for customer classes where all consumers have similar load profiles such as lighting class customers, the non-coincident peak will be similar to the maximum individual class peak. In this case, the within-class diversity is low. Differences between the three types of load definition are illustrated on the table below:

Diverse Customer Class

	Ski Slope	Swimming Pool	Football Stadium	**Total for Class**
Winter Load	100	0	0	
Peak Load Hour	0	100	0	
Autum Load	0	0	150	
Maximum Individual Demand				**300**
Coincident Peak Demand				**100**
Non-Coincident Peak Demand				**150**
Coincidence Factor - Coincident Peak				**33%**
Diversity Factor - Coincident Peak				**3.00**
Coincidence Factor - Non-coincident Peak				**50%**
Within Class Diversity				**2.00**

Non-Diverse Customer Class

	Ligting 1	Ligting 2	Ligting 3	**Total for Class**
Winter Load	100	100	100	
Peak Load Hour	0	10	0	
Autum Load	100	100	100	
Maximum Individual Demand				**300**
Coincident Peak Demand				**10**
Non-Coincident Peak Demand				**300**
Coincidence Factor - Coincident Peak				**3%**
Diversity Factor - Coincident Peak				**30.00**
Coincidence Factor - Non-coincident Peak				**100%**
Within Class Diversity				**1.00**

There are a host of problems with use of non-coincident peak to allocate distribution costs. First, non-coincident peak has nothing to do with regional peak demands and is measured on a system-wide basis just as is the case for coincident peak. Second, and more importantly, the within-class diversity that is so beneficial to certain classes in measuring NCP has nothing whatsoever to do with cost causation. In the example above the within class diversity for the first customer class is high, but for the second it is low. Third, the manner in which sampling is performed affects non-coincident load and the sampling creates distortions for customer classes that do not have time recording meters.

Sampling in Load Research and Calculation of NCP

To illustrate how coincident peak is affected by sampling issues, consider a simple example in which only one residential consumer is used in the sampling process out of a population of 10 consumers. Assume that there are only two customer classes, there are no line losses, and that the measured peak load for the system is 1,500. Further assume that there is no uncertainty in measurement of loads and they are the same in each hour year after year. Finally, assume that the system is very small with only one substation, that one set of primary feeders serves all of the consumers (*i.e.* there is only one region.) This may seem like a contrived example, but once the assumptions are restricted the logic and principles do not change.

If the measured load of the class that has time recording meters is 700, then the implied residential load is 800 as shown on the table on the next page. If there are 10 residential ratepayers and the sample for the one customer is 80 at the time of the coincident peak, then the peak at the coincident peak load are measured accurately. Note that in this extreme case, developing the load research would not even be necessary for purposes of computing the coincident peak. However while computing coincident peak is relatively straightforward, the accuracy of computing the diversity of sampled residential consumers becomes murky. The maximum load over the course of the year may be different for the single sampled ratepayer than for other hours creating diversity, but this diversity is far less than the true diversity that would be measured had a time recording meter be put on every single ratepayer. Therefore, in this extreme case, the coincident peak may be measured on a reasonable basis for each class, but the diversity for the residential class requires a larger sample represent the individual or NCP on an accurate basis.

CP versus NCP and the Number of Consumers in a Customer Class

NCP is biased in favor of large customer classes. In contrast, CP and Maximum Individual Demand are not affected by the number of ratepayers in the class. In allocating costs one would think that the costs attributed to a particular ratepayer should not be affected by whether the consumer is part of a large class or a small class. For allocations that apply CP and Maximum Individual demand, however, this is the case. In the case of NCP, cost

allocations are biased in favor of classes that have a large number of consumers. To see this, I have created another simple example in which different sized customer classes are created. In this example, I assume ten different consumers each with a different load profile and to make the example simple I assume only three periods in a year, one of which is the coincident peak period. If each consumer is a different class, then the coincident load for the total of all the ten customers is the same as if each customer were a separate class. However, when NCP is applied and the customers are split into different classes, the cost allocation changes depending on the how the individual customers are picked for "teams" to be placed into various classes. If all customers are separate classes the answer is very different than if some are picked on for the large class while others remain independent. The table below illustrates how total NCP varies depending on the size of the class while total CP is independent of the number of customers in a class. Note that the column for the total CP and for the total individual peak remains the same across customer class definitions while the NCP changes depending on how the classes are defined.

Total Consumers on System

	Customer 1	Customer 2	Customer 3	Customer 4	Customer 5	Customer 6	Customer 7	Customer 8	Customer 9	Customer 10	Total
Winter Load	100	60	100	120	10	200	20	20	80	20	730
Peak Load Hour	80	160	40	80	8	50	60	120	80	122	800
Autum Load	60	80	30	60	4	20	80	100	250	80	764
Maximum	100	160	100	120	10	200	80	120	250	122	1262
NCP											730

	Two Equal Customer Classes								
Class Definition	Class 1 CP	Class 2 CP	Total CP	Class 1 NCP	Class 2 NCP	**Total NCP**	Class 1 Ind	Class 2 Ind	Total Ind
Two Equal Classes	368	432	800	390	530	**920**	490	772	1262
Customer 1/Aggregate of 2-10	80	720	800	100	720	**820**	100	1162	1262
Customer 10/Aggregate 1-9	678	122	800	710	122	**832**	1140	122	1262
One Single Class	800	0	800	800	0	**800**	1262	0	1262

The issue of customer class size proves that there is something wrong with allocating costs using the NCP approach. The aggregate cost of primary lines and distribution substations has nothing to do with rate design and ComEd's rate department. I doubt that ComEd engineers and contractors ask about the definition of customer classes before they build new facilities. But this is the implication of allocation with NCP. The amount of electricity actually delivered over the lines does not know which ratepayer is creating the load and the size of the equipment must be the same no matter how different customer groups are designed. This point alone proves that NCP is an inappropriate basis for allocating costs.